

Bachelor-/ Master-Thesis



TECHNISCHE
UNIVERSITÄT
DARMSTADT



Center of
Smart Interfaces

Electric charge advection driven by a temperature-dependent surface tension and applicable as a waste energy recovery unit

Motivation

Heat emitted for instance from the central processing units of computers is commonly dissipated to the environment without further use. Sustainability efforts aim to recover parts of the waste heat and convert it into a more useful form of energy. Viable approaches must be robust and available at ultra-low cost for large-scale application. Here, we are considering thermally driven electric charge transport in micro-flows as a possible option.

Outline

The distribution of free ions in a weakly conducting electrolyte becomes spatially non-uniform near walls with a surface charge and the excess ions can be advectively transported with a flow in a micro-channel to generate a streaming potential along its axis, Fig. 1. This concept is commonly used in novel pressure-driven micro-batteries. The streaming potential leads to an undesired backflow of ions due to a conduction current, severely diminishing the conversion efficiency. Partitioning the liquid into parcels suppresses the conduction current since the air in between two neighboring parcels is electrically insulating. Such parcels are known to move in a lateral thermal gradient if the surface tension of the two bounding capillary interfaces is temperature-dependent (thermocapillarity). Experiments shall access whether an electric charge injected or accumulated in an electrolyte parcel due to electrokinetic streaming can be transported by thermocapillarity along the channel against the action of an electric field and then ejected again. This acts as a thermally driven charge conveyor belt, Fig. 2, and the transported charge per time needs to be recorded as a function of the temperature difference and the opposing electric field. From this the thermal conversion efficiency will be deduced.

Tasks

- setup & operation of experiments, data analysis, documentation

Requirements

- General interest & knowledge in fluid mechanics & thermodynamics
- Experience in setting up experiments is beneficial
- Knowledge of electrostatics /-chemistry is helpful

Center of Smart Interfaces
Understanding and Designing
Fluid Boundaries



Center of
Smart Interfaces

Dr. Mathias Dietzel



Petersenstraße 32
64287 Darmstadt

Tel. +49 6151 16 - 2839
Fax +49 6151 16 - 72021
dietzel@csi.tu-darmstadt.de

Datum: 19.01.2012

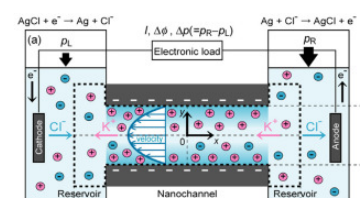


Fig. 1: Electrokinetic streaming

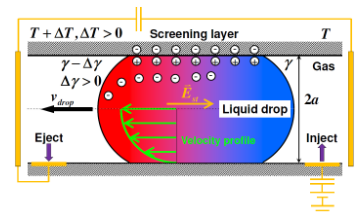


Fig 2: Thermocapillary streaming

